REMARKS

This Amendment is in response to the Office Action mailed October 26, 2001. No new matter is believed to be added to the application by this Amendment.

Status of the Claims

Claims 4-34 are pending in the application. Claims 4-20 are rejected. The amendments to the claims clarify their language and do not narrow the scope of the claims. Claims 21-28 are newly presented for the Examiner's consideration. Support for newly added claims 21-23 can be found at page 4 of the specification. Support for newly added claims 24-27 can be found at page 15 of the specification. Newly added claim 28 corresponds to claim 4.

Interview with the Examiner

Applicants thank the Examiner for graciously conducting an interview on February 21, 2002. The Examiner Interview Summary Record (Paper No. 22) has been reviewed, and it appears to accurately reflect the substance of the interview.

Rejection Under 35 U.S.C. §112, second paragraph (paragraphs 2-3 of the Office Action)

Claims 4-20 are rejected under 35 U.S.C. §112, second paragraph, as not being indefinite. Applicants traverse this

rejection and respectfully request reconsideration and withdrawal thereof.

In paragraph 3 of the Office Action, the Examiner considers the term "type" to be indefinite. The Examiner's comments have been considered. The claims as amended do not contain this term. Accordingly, this rejection is overcome, and withdrawal thereof is proper.

Rejection Under 35 U.S.C. §103(a) over Soma (paragraph 4 of the Office Action)

Claims 4-11 are rejected under 35 U.S.C. §103(a) as being obvious over Soma (U.S. Patent No. 5,411,767). Applicants traverse this rejection and respectfully request reconsideration and withdrawal thereof.

Soma pertains to a method for producing an interconnector for a solid electrolyte type fuel cell that utilizes thermal spraying technology. Soma fails to teach a sintered or co-sintered interconnector. Soma additionally fails to teach or suggest the interconnector being integrally burned within the battery. Soma further fails to teach or suggest that the interconnector current collection is in the vertical direction. Soma also fails to teach or suggest a matrix of the general formula such as is set forth in

independent claims 6 and 8. The Examiner admits the failings of the Soma reference at page 3 of the Office Action.

In the Office Action, the Examiner asserts that vertical current collection is a matter of design choice. However, if the current collection direction is vertical, it is then possible to have a thin film thickness to thereby lower excess voltage caused owing to the resistance of the interconnector 14, shown in FIGS. 44(a) and 44(b). The advantages of vertical current collection are further discussed at pages 33 and 34 of the specification. Applicants note that vertical current collection is equally applicable to flat-plate and cylinder-shaped fuel batteries of the invention, and the drawings set forth in FIGS. 44(a) and 44(b) can be viewed as a schematic cross-sectional views cut along the longer axial direction of a cylinder-shaped fuel battery with a laterally striped pattern. As a result, the vertical current collection yields advantages that are neither taught nor suggested by the Soma reference.

In the Office Action, the Examiner asserts that the subscript ranges of the $(La_{1-x}D_x)_{1-u}B_{1-w}O_3$ have not been shown to be critical. Applicants respectfully note that FIG. 30 of the application shows the criticality of the $x = 0.2$ limitation, and this result is

directly opposite the teachings at column 4, lines 44 and 45, of Soma.

In the present invention, when employing an ABO_3-based matrix as a material for the interconnector, the inventors found through theoretical and practical experimentation that current conductivity can be improved by limiting B of ABO_3 to Ti and using the n-type semiconductor property thereof. Furthermore, the inventors predicted that a bivalent alkaline earth metal, such as Mg, Ca, Sr, or Ba, would offer excellent properties as A when Ti is selected for B based on crystallographic characteristics. This prediction was proven by the inventors' subsequent experimental work.

While Soma apparently suggests using a material represented by a formula of ABO_3, the present invention discloses a composition which does not utilize La and Cr, which have been used in the prior art. A total of 20 different elements can be used as A, including rare earth elements but excluding La and alkaline earth. On the other hand, 16 different elements can be used as B, including Ti, V, Mn, Fe, Co, Ni, Cu, Zn, Mg, Al, Pb, Ru, Re, Nb, Mo, and W. Therefore, ABO_3 can be derived from 320 combinations for the compound (20 x 16 = 320). Taking into account partial substitution of A and B, the number of possible combinations would be fantastically high. See new claim 28.

In contrast, the examples of Soma have only two general formulas: $(Y_{0.8}Ca_{0.2})FeO_3$ and $Y(Fe_{0.8}Ni_{0.2})O_3$. Furthermore, Soma employs a thermal spray method, and the principle of operation must be changed in order to utilize the Soma reference (as has been discussed in prior responses).

At page 4 of the Office Action, the Examiner asserts that the "co-sintered" and "integrally burned" limitations are essentially process limitations that do not distinguish over Soma. However, sintering is not only a process, but can also be used to describe the physical state of a material. See pages 3, 5, 6, and 34 of the specification.

In the present invention, the material for the interconnector is limited to three types of compounds: $MTiO_3$ (M = Ca, Sr, Ba). Various types of the compounds, wherein partial substitution of the elements has taken place, can be applied for an integrally sintered type fuel battery. Moreover, the sintering need not be done at a high temperature as in the prior art, since it has been clearly demonstrated that material sintered at relatively low temperatures (1300-1400°C) exhibits excellent durability and resistance to the heat cycle.

As has been shown, the teachings of Soma are insufficient to allege a case of *prima facie* obviousness over the instantly claimed

invention. Further, even if a *prima facie* case of obviousness could be made over Soma, unexpected results rebut any *prima facie* obviousness that can be alleged. These unexpected results were presented in the declaration under 37 C.F.R. §1.132 filed February 12, 2001. This declaration set forth the advantages of the process and interconnector of the present inventions, including such advantages as reductions in material cost, process steps, and equipment investment. For the Examiner's convenience, two explanatory slides from the declaration are appended to this Amendment as Exhibit 1.

As has been shown, Soma fails to demonstrate *prima facie* obviousness over the present invention. Even if Soma were sufficient to produce a *prima facie* case of obviousness, unexpected results clearly rebut this obviousness. Accordingly, this rejection is overcome, and withdrawal thereof is proper.

Rejection under 35 U.S.C. §103(a) over JP 8-50913 in view of Soma (paragraph 5 of the Office Action)

Claims 4-20 are rejected under 35 U.S.C. §103(a) over JP 8-50913 in view of Soma. Applicants traverse this rejection and respectfully request reconsideration and withdrawal thereof.

JP '913 pertains to a solid electrolyte type fuel cell in which the air electrode and the interconnector can be

simultaneously molded. JP '913 fails to disclose the material of the interconnector.

In the conventional fuel battery shown in FIGS. 5 and 6 of JP '913, a solid electrolyte layer 14 is formed at the outer circumference of the cylinder-shaped air electrode 13, and a fuel electrode is formed on the outer frame of the solid electrolyte layer 14. FIG. 1 of JP '913 shows an interconnector 24 molded to a part of the cylinder portion of the air electrode that concurrently acts as a support tube. Although this structure may achieve a small-size, lightweight fuel battery, the JP '913 reference merely discloses the feature of integrally sintering electrodes in the manufacturing process of the fuel battery.

The Examiner then turns to the teachings of Soma for the materials of the interconnector. However, the inability of Soma to be utilized to allege *prima facie* obviousness has been discussed above. As a result, there is no basis to combine JP '913 with Soma to allege *prima facie* obviousness. Even if the references could be combined, the unexpected results of the invention fully rebut any *prima facie* obviousness that can be made. Accordingly, this rejection is overcome, and withdrawal thereof is proper.

Information Disclosure Statements

Applicants thank the Examiner for considering the Information Disclosure Statements filed July 20, 1998, and February 19, 1999, and for making the initialed Forms PTO-1449 of record in the application in the Office Action mailed October 29, 1999 (Paper No. 5).

Conclusion

Pursuant to 37 C.F.R. §§1.17 and 1.136(a), applicants hereby petition for a three-month extension of time in which to file a response to the Office Action of October 26, 2001. A check in the amount of $920 is attached.

If the Examiner has any questions concerning this application, he is invited to contact Robert Goozner, Ph.D. (Reg. No. 42,593), at (703) 205-8000 in an effort to expedite prosecution.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or to credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17, particularly extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By Marc Weiner

Marc S. Weiner, #32,181

965-232P
Attachments
MSW:REG:rk

P. O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Claims 4-17 have been amended as follows:

4. (Twice Amended) A solid electrolyte **[**type**]** fuel battery, in which **[**an**]** a sintered interconnector **[**produced by sintering**]** is used for connecting cells of the solid electrolyte **[**type**]** fuel battery, and the sintered interconnector comprises a material having a matrix of the general formula $MTiO_3$ where M is Mg, Ca, Sr, or Ba.

5. (Twice Amended) The solid electrolyte **[**type**]** fuel battery as claimed in claim 4, wherein the current passage of the interconnector is current collection in the vertical direction from a fuel electrode through the interconnector.

6. (Twice Amended) A solid electrolyte **[**type**]** fuel battery, in which a co-sintered interconnector for connecting cells of the solid electrolyte **[**type**]** fuel battery comprises a material having a matrix of the general formula $A_{1-x}B_xC_{1-y}D_yO_3$ where A is Ca, Sr or Ba, B is a rare earth element, aluminum or chromium, C is titanium, D is niobium or tantalum, $0 < x \le 0.2$ and $0 \le y \le 0.2$.

7. (Amended) The solid electrolyte **[type]** fuel battery as claimed in claim 6, wherein the current passage of the interconnector is current collection in the vertical direction.

8. (Twice Amended) A solid electrolyte **[type]** fuel battery, in which a co-sintered interconnector for connecting cells of the solid electrolyte **[type]** fuel battery comprises a material having a matrix of the general formula $A_{1-x}B_xC_{1-y}D_yO_3$ where A is Mg, B is a rare earth element, aluminum or chromium, C is titanium, D is niobium or tantalum, $0 < x \leq 0.2$ and $0 \leq y \leq 0.2$.

9. (Amended) The solid electrolyte **[type]** fuel battery as claimed in claim 8, wherein the current passage of the interconnector is current collection in the vertical direction.

10. (Amended) A solid electrolyte **[type]** fuel battery, in which an interconnector for connecting cells of the solid electrolyte **[type]** fuel battery comprises a material having a matrix of the general formula $MTiO_3$ where M is Mg, Ca, Sr, or Ba, wherein the interconnector is integrally burned within said battery.

11. (Twice Amended) The solid electrolyte **[type]** fuel battery as claimed in claim 10, wherein said battery comprises a fuel

electrode, an electrolyte, an interconnector and an air electrode laminated onto a substrate, which are integrally burned within said battery.

12. (Twice Amended) A method of making a solid electrolyte [type] fuel battery, in which an interconnector for connecting cells of the solid electrolyte [type] fuel battery is [of a co-sinter type] co-sintered, and comprises a material having a matrix of the general formula $MTiO_3$ where M is Mg, Ca, Sr, or Ba, said method comprising:

integrally burning within said battery the interconnector for connecting cells of the solid electrolyte [type] fuel battery.

13. (Twice Amended) The method of making the solid electrolyte [type] fuel battery as claimed in claim 12, wherein said battery comprises a fuel electrode, an electrolyte, an interconnector and an air electrode laminated onto a substrate.

14. (Twice Amended) A method of making a solid electrolyte [type] fuel battery, in which a co-sintered interconnector for connecting cells of the solid electrolyte [type] fuel battery comprises a material having a matrix of the general formula $A_{1-x}B_xC_{1-y}D_yO_3$ where A is Ca, Sr or Ba, B is a rare earth element, aluminum or chromium, C is titanium, D is niobium or tantalum, $0 < x \leq 0.2$ and

$0 \leq y \leq 0.2$, said method comprising:

integrally burning within said battery the interconnector for connecting cells of the solid electrolyte [type] fuel battery.

15. (Twice Amended) The method of making the solid electrolyte [type] fuel battery as claimed in claim 14, wherein said battery comprises a fuel electrode, an electrolyte, an interconnector and an air electrode laminated onto a substrate.

16. (Twice Amended) A method of making a solid electrolyte [type] fuel battery, in which a co-sintered interconnector for connecting cells of the solid electrolyte [type] fuel battery comprises a material having a matrix of the general formula $A_{1-x}B_xC_{1-y}D_yO_3$ where A is Mg, B is a rare earth element, aluminum or chromium, C is titanium, D is niobium or tantalum, $0 < x \leq 0.2$ and $0 \leq y \leq 0.2$, said method comprising:

integrally burning within said battery the interconnector for connecting cells of the solid electrolyte [type] fuel battery.

17. (Twice Amended) The method of making the solid electrolyte [type] fuel battery as claimed in claim 16, wherein said battery comprises a fuel electrode, an electrolyte, an interconnector and an air electrode laminated onto a substrate.

Claims 21-28 have been added.

EVALUATION of Interconnecter

Preparation Method of Interconnecter

MO or MCO_3	TiO_2	Ln_2O_3
($CaCO_3$ etc)		(La_2O_3 etc)

Mixing (Ball Mill, 24h)

Calcination (1473K × 5h)

Grinding (Ball Mill, 48h)

Forming (CIP, 200MPa)

Sintering

Characterization

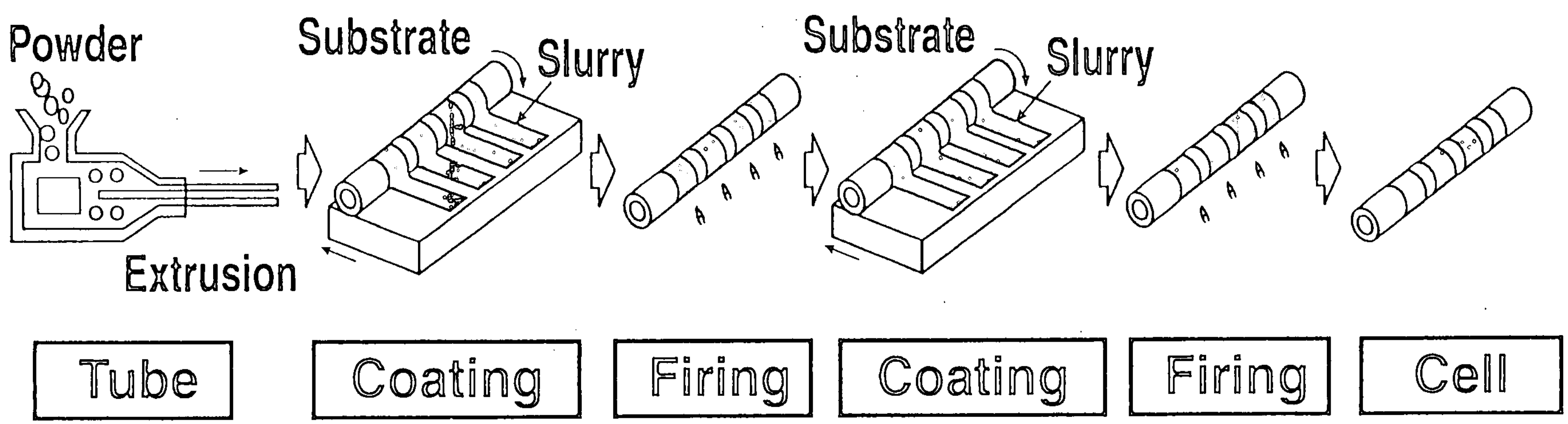
Manufacturing of Sintered Cell (Next Page)

MITSUBISHI HEAVY INDUSTRIES, LTD.

O.98.6
08

PERFORMANCE of Sintered Cells and Module

Manufacturing Process of Sintered Cell



POINT		EFFECT
① High Yield	⇨	Reduction of Material Cost
② Non Masking	⇨	Reduction of Process
③ Simple Facilities	⇨	Reduction of Equipment Investment

MITSUBISHI HEAVY INDUSTRIES, LTD.